PUBLIC WORKS.

CITY COUNTY STATE

A COMBINATION OF

"MUNICIPAL JOURNAL" and "CONTRACTING"

Waterbound macadam road looking north from village of Saugatuck, Michigan, treated with "Tarvia-B" in 1917, 1918 and 1919.

West Michigan Pike, near village of Douglas, Mich. Waterbound macadam treated with "Tarvia-B" in 1917, 1918 and 1919.

Inoval: Waterbound macadam road near South Haven, Mich., patched with "Tarvia-KP" and treated with "Tarvia-B" 1918, 1919.

West Michigan Pike, Van Buren County, Michigan. Waterbound macadam roadway treated with "Tarvia-B" in 1918 and 1919. Part of a 15 mile stretch of Tarviated roadway.

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 49 FLORAL PARK, SEPTEMBER 11, 1920 No. 11

Flow of Water in Ditches

Experiments conducted by engineers of the Bureau of Roads to determine the proper values of the co-efficient in Kutter's formula for various conditions of channels in earth; the conditions being indicated by photograph, cross-section and description.

An extensive series of experiments to determine the coefficient of roughness in Kutter's formula has been carried on under the direction of C. E. Ramser, senior drainage engineer of the Bureau of Public Roads of the U. S. Department of Agriculture, and a description of the tests is given at length and the conclusions set forth in a professional paper published by the department under the date of June 7, 1920.

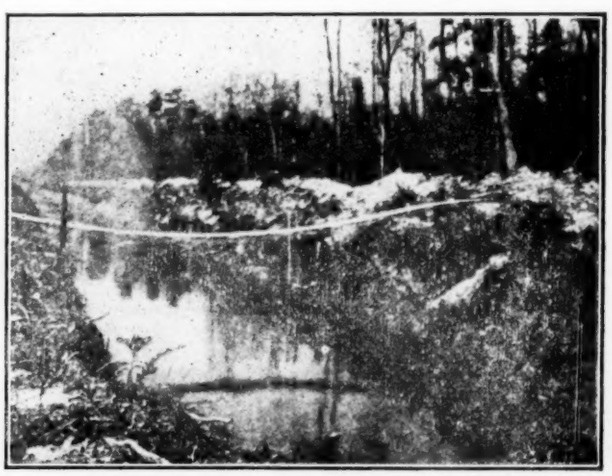
Mr. Ramser quotes the engineers of the Miami Conservancy District as holding the opinion that "Although the Kutter formula is not ideal, it is the best equation available at the present time." The reliability of the value of formula depends upon the selection of the coefficient of roughness *n*. The experiments which are described were made for the purpose of determining just what values of *n* properly apply to the various conditions of channel in the case of dredged drainage ditches.

Mr. Ramser calls attention to the fact that the value of *n* is affected not only by friction on the bed of the stream, but also by irregularities in the wetted perimeter, non-uniformity of cross section in size and shape, growth of vegetation in the channel, and presence of other obstructions to flow, such as rocks, drift, etc. An engineer who has not had wide personal experience in the selection of *n* for different conditions of channels must depend for a choice of value upon descriptions of channels as given by others. In this report photographs and careful descriptions of the channels for which the values of *n* were determined are presented as being the best method of making the results of the investigation practically applicable for use by other engineers.

Experiments were conducted in six different localities in Mississippi, Tennessee, Iowa, North Carolina, and Florida. Four sets were made by by Mr. Ramser, those in North Carolina by A. D. Morehouse and those in Florida by F. E. Staebner, all three drainage engineers of the Bureau of Public Roads. They were conducted under the direction of S. H. McCrory, chief of drainage investigations.

Because of the necessity just stated of selecting, for any given case, a value of *n* which has been found to apply to a channel as nearly as possible similar to the one in question, the special value of the report lies in the complete set of photographs and descriptions which accompany it. The photographs, sections and tables shown

SOUTH FORKED DEER RIVER (OLD CROOKED)
Channel Clogged with Stumps and Brush.



LITTLE JACOB SWAMP DREDGED CHANNEL
Shows Suspended Foot Bridge for Measuring Current Velocities.

COURSES OF RIVERS AT WHICH SLOPE OR FALL OF SURFACE WAS DETERMINED.

herewith give an illustration of the completeness with which the descriptions of the various ditches measured are given in the report. In addition to these data, the bulletin gives a few conclusions from a study of the results which were reached by the author, these being as follows:

CONCLUSIONS

"(1) That a deposit of slick, slimy silt on the sides and bottom of a channel greatly reduces frictional resistance to flow.

"(2) That the clearing of perennial growth from a channel will greatly increase its capacity.

"(3) That the growth of grass and weeds in a channel during the summer greatly decreases its capacity.

"(4) That the accumulation of drift, trees, logs and other obstructions in a channel greatly decreases its capacity.

"(5) That after a certain amount of erosion has taken place in a channel, further erosion does not necessarily increase the roughness of the perimeter.

"(6) That the roughness coefficient n is appreciably higher for a roughly dredged channel than for a smoothly dredged one.

"(7) That ordinarily a dredged channel quickly deteriorates in hydraulic efficiency unless systematically maintained.

"(8) That abrupt variations in cross section play an important part in reducing the hydraulic efficiency of a channel.

"(9) That generally, in designing a proposed dredged channel, a value of n of 0.030 should be used if the channel is to be smoothly dredged, and of 0.035 if roughly dredged. If the above values are used, the channels should be carefully maintained, and if not to be so maintained a value of n should be selected in accordance with the worst anticipated conditions for the channel. However, if it is known that such conditions will obtain as were found for some of the channels in western Iowa, a somewhat lower value of n may be used, depending upon the anticipated conditions of the channel.

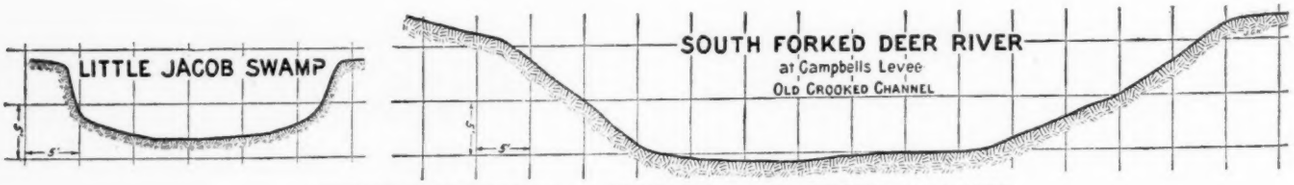
"(10) That in computing the capacity of an existing channel the value of n chosen should, whenever possible, be based upon a comparison of the conditions in the existing channel with the condition of channels for which values of n have been determined; such comparison being made, if not by actual inspection, at least with the aid of careful descriptions and views of the investigated channels."

In connection with the use of the report for determining the value to be employed for n in any particular case, the author gives the following suggestions:

"In order to determine the capacity of a proposed dredged channel, it is necessary to assume anticipated conditions of channel. As is readily seen from the results of these experiments, values of n for dredged channels vary greatly, depending principally upon irregularities of side slopes and cross section due to erosion, caving banks,

Date of observation.	Average maximum depth.	Average surface width.	Discharge.	Average cross section.	Mean velocity.	Mean hydraulic radius.	Slope of Water surface.	Coefficient in formula $V = c\sqrt{RS}$	Coefficient of roughness, n	Description of Channel.
Little Jacob Swamp Dredged Channel near Lumberton, N. C.										R
DURING WINTER MONTHS										
Feb. 22, 1915	0.9	13.0	6.5	10.3	0.63	0.69	0.000448	35.8	0.0332	Course, straight; 500 feet long. Cross section, very little variation in shape; for variation in size, see fig. 10 D. Side slopes, fairly regular. Bottom quite even and regular. Soil, clay; sandy bottom due to silting. Condition, some moss along course; very little foreign material in channel. Constructed, July, 1913.
Jan. 13, 1915	1.0	13.6	13.7	12.4	1.10	.79	.000738	45.4	.0282	
Jan. 19, 1915	1.5	17.2	24.1	19.6	1.23	1.08	.000630	47.1	.0293	
Jan. 25, 1915	1.6	17.5	26.7	20.5	1.30	1.11	.000566	52.0	.0270	
.....	[1]7.0	....	....	....	....	....	.....	....	.....	
DURING SUMMER MONTHS										
June 28, 1915	0.65	10.0	2.2	6.3	0.35	0.50	0.000308	28.2	0.0362	Course, same as next above. Condition, light growth of grass and weeds along edge of low water flow.
June 15, 1915	.7	10.5	2.8	6.8	.41	.53	.000314	31.7	.0335	
June 11, 1915	.8	11.0	4.5	8.6	.52	.62	.000322	36.8	.0310	
May 19, 1915	.9	12.0	5.4	10.1	.53	.70	.000360	33.3	.0348	
May 15, 1915	1.4	17.0	15.4	17.4	.89	1.01	.000318	49.7	.0272	
May 13, 1915	2.2	20.0	29.5	32.9	.90	1.55	.000176	54.5	.0275	
.....	[1]7.0	....	....	....	....	....	.....	....	.....	
Old Crooked River Channel										
Mar. 20, 1916	5.1	46.5	395.2	241.2	1.64	4.15	0.003773	13.1	0.1520	Course, very crooked, containing four distinct curves; 705 feet long at low water. Cross section, large variation in shape; for variation in size, see fig. 6 M. Side slopes, very irregular. Bottom, very irregular and full of holes. Soil, sandy clay loam. Condition, many roots, trees, and bushes on sides, and many logs, large trees, and other drift on bottom; trees are continually falling into channel, due to caving banks.
Feb. 25, 1916	6.5	50.0	545.9	311.5	1.75	4.99	.003812	12.7	.1620	
Mar. 29, 1916	7.6	54.0	735.7	366.0	2.01	5.56	.003450	14.6	.1500	
Mar. 4, 1916	7.8	55.0	715.1	376.7	1.90	5.68	.002709	15.3	.1460	
Feb. 3, 1916	11.1	64.5	1006.6	575.8	1.85	7.60	.001486	17.4	.1400	
.....	[1]13.0	....	....	....	....	....	.....	....	.....	

[1] Average maximum depth at bankful stage.



AVERAGE CROSS-SECTION OF CHANNELS AT MEASUREME NT POINTS

or faulty construction; upon obstructions and growth in the channel due to a lack of maintenance; and, under certain conditions, upon the effect of a lining of silt in the channel. In most cases where erosion takes place in a newly-constructed and well-finished dredged channel, the roughness coefficient increases but the capacity of the channel as a rule also increases, since the enlarged cross section more than offsets the effect of the increased roughness coefficient. In some instances practically no difference in capacity in a newly dredged channel may result due to erosion, after a certain amount of erosion has taken place, as was found to be the case for the experiments conducted at Trenton, Tenn."

For actually measuring the discharge, the gauging stations were with few exceptions located on single-span bridges so that there was no interference with the natural flow of the water. Where suitable bridges did not exist at desirable sections, temporary suspension foot bridges were constructed spanning the ditch. At one site a cable was used, from which the carriage carrying the observers was suspended.

The velocity measures were made with a small Price current meter. They were made at intervals of 2½ feet across the stream for the smallest channels, at 5-foot intervals for medium-sized channels, and at 10-foot intervals for the largest channels. At each measuring point the velocity was determined at the surface, mid-depth and the bottom of the stream. In a few instances the velocity was measured at 0.2 and 0.8 of the depth.

Carefully made soundings were obtained during low-water stages at the velocity-measuring points and also wherever a decided change in the perimeter of the channel took place. As a check on these measurements and to detect any changes due to silting or erosion, soundings were made also at the time of the velocity measurements.

Macadam is "Pavement" in Pennsylvania

In cases brought to trial in certain cities of New York state, if we remember correctly, it has been decided that macadam is not a "pavement" as that term is used in the laws which provide that property owners can be assessed for the cost of only one pavement, and that repairs and renewals must be paid by the city at large. The city of Pottsville, Pennsylvania, is now confronted with the necessity of repaying to Market street property owners the amount which they had paid to the city as an assessment of benefits in connection with paving that street with wood block.

It seems that, when the city endeavored to assess all property owners for their share of this pavement, some of them refused to pay the assessment, claiming that the macadam which they had already paid for constituted a pavement under the law and that, therefore, they could not be assessed for any further paving. This view was upheld by the Schuylkill county court and also by the Superior and Supreme courts, all deciding that the council had no power to levy an assessment for a pavement where the property owners had already paid for macadam in front of their properties.

The legal snarl is by no means settled, however, since it was found that council had no power to return money that had been paid into the treasury; some claiming that they cannot do so even if the legislature has passed an act enabling them to do so.

In spite of this experience of Pottsville, it is said that a number of cities in the state are assessing the cost of repaving streets under similar conditions.

Cause of Waves in Asphalt Pavements

In the July 24th issue of PUBLIC WORKS we published an article calling attention to the fact that English engineers have been showing an appreciation of American practice and paying considerable attention to the methods used in this country, recommending many of them for adoption. In the July 22nd issue of the London paper therein quoted from we find the following letter, in which the American type of asphalt roller is described as being superior to the English type.

(*To the Editor of* MUNICIPAL ENGINEERING AND THE SANITARY RECORD.)

SIR—The correspondence on this subject is highly interesting and most instructive. But I cannot agree with "Asphalt in your last issue, who appears to conclude that there is only one cause governing the corrugation or waviness of asphalt roads. There are, in my opinion, several, of which the following, as one who has supplied and laid a very considerable number of thousands of yards, are examples, viz.:—(1) Improper laying of the material with workmen of insufficient experience, for the material should be laid at a given temperature. If it is allowed to fall below a minimum temperature, the material will come out in a lumpy state from the vans delivering it on the road. (2) The iron rakes for levelling out the material are not made sufficiently hot to penetrate into the asphalt, the consequences being that the raking out of the lumps is not effected. They are scratched over only, and corrugations result. (3) Improper types of rollers used for oiling asphalt macadam are, in my opinion, another cause of corrugations. That this is so, I have proved when laying asphalt macadam into two adjacent roads with two different types of rollers, viz., one of the English type, where the engine is built above the level of the wheel axles; whilst the other was of the American type of roller, with the engine below the level of the axles, and so low indeed that it is only about 8in. clear of the ground. Much superior results were obtained with the latter roller, although the conditions as regards the composition and the heating of the material, etc., were similar. The presence of corrugations in the former and their absence in the latter were very perceptible. (4) Another cause of trouble arises from excessive thickness of the material, producing unequal compression. The standard thickness of 3½ in. in two-coat work should not be exceeded. (5) The improper bonding of the upper and lower coats is another cause leading to the formation of corrugations If the lower or under coat is of too coarse material, then the upper or carpet coat material is driven into it. The proper gauging of the materials of the two coats is most important, and especially, too, is the combination of the gauges of sands in the upper or carpet coat.

These are, in my experience, some of the causes which lead to the corrugations or waviness in asphalt macadam.

Yours faithfully,

July 17th, 1920. ROAD BUILDER.

Hydraulic Fill Construction of Huffman Dam

Deficiency of fine material for core supplied by excavating hillside with monitor and sluicing it to core pool at minimum cost.

The building of the Miami Conservancy works furnishes the most recent and important illustration of the construction of great earth dams by the hydraulic fill process that has been developed since its first use many years ago in placer mining.

The conduct of the Miami Convervancy work under the charge of an able board of designing, supervising and consulting engineers that have made thorough investigations, analyses, experiments and tests, has done much to advance the theory and practice of construction by this method and to govern them by rational considerations and practical operations. Careful studies have indicated the causes of failures of some previous hydraulic fill dams and have shown their remedies. Accurate observations and records of the progress of the work have also demonstrated the stability of the work in progress, and provided data from which the engineers have been able to modify the designs and operations so as to secure safe and economical results under varying conditions.

In the construction of the Huffman dam, difficulties that were anticipated before the work was commenced have been met and successfully surmounted by a method here described, which varied the character of the material used, improved and reduced the total cost. This was accomplished by supplementing the original supply of material by a second supply and by varying the details of the methods employed for handling it.

The five great conservancy dams in the Miami valley are all being built by the hydraulic fill method, as described at some length in the May 8 and 15 issues of Public Works. As there stated, there are three essential elements in each dam—the levees, beaches, and core. The correct proportioning of the core to the other elments of the dam is of vital importance because, if the core is too thin, it is likely to lack water-tightness, and if too thick, it may burst through the sides of the dam before the original semi-fluid consistency becomes hardened to its final character. In the conservancy dams, the thickness of the core at any point is made approximately equal to the distance from that point to the top of the dam, thus making the maximum thickness not more than one-fifth of the width of the dam base.

Great care was exercised in selecting the materials for the Miami dams, which were chosen in accordance with indications given by test borings sunk to explore the subterranean strata, and in accordance with the position of the material relative to the dam and the facility of excavating and transporting it.

In the case of the Huffman dam, the principal borrow pit was located in the bottom of the valley just above the dam site, where the graded material secured for the levees, the beaches and the core, was lacking in a sufficient proportion of fine material for the last named. As the dam progressed, the water delivered to the core pool, which was kept at normal height and width, deposited so little sediment that the silt thus supplied was insufficient to fill the interstices between the particles of sand and gravel in the retaining embankments and the latter were thus unable to keep themselves water-tight. Consequently the water leaked through the beaches and levees at the rate of about 6,000 gallons per minute, requiring the operation of a 15-inch dredge pump to maintain the required pool level, and caused a serious deficiency of the sedimentary deposit necessary to bring up the body of the core to its required position.

The obvious remedy for this difficulty was to provide a larger proportion of fine material in the gravel, earth, silt and sand that were discharged through the pump pipes into the core pool.

It would have been possible to accomplish this by limiting the depth of excavation in the borrow pit, but at a considerable increase of the cost of digging and transportation. Another method considered was by steam shovel excavation in a clay bed at another point and the transportation of this spoil to the hog-box, where it could be mixed with the material from the regular borrow pit, an operation which also involved considerable expense in the purchase of an additional plant. Both of these plans were abandoned in favor of the one indicated in the accompanying diagram, which was adopted and is giving excellent satisfaction.

An hydraulic monitor was installed on the hillside at a point about 200 feet from the north end of the dam and 25 feet above it, where the soil was composed of 2 to 8 feet of yellow clay with some sand and gravel and 4 to 12 feet of hard blue clay laminated in places with shale.

The monitor, working up the steep slope, excavated 6 feet or more of this surface material

which was washed down to the bottom of the excavation and thence sluiced to the bottom of the hill The elevation of the borrow pit and the distance from the dam were such that a considerable portion of the material could be sluiced directly to the core pool. The remainder was sluiced to a sump and then pumped to the pool.

HYDRAULICKING

The additional core material is excavated by a special hydraulic monitor designed with a very powerful jet, enabling it to cut through the refractory clay and shale strata and supply sufficient water to sluice the spoil without the additional low pressure stream generally supplied for this purpose.

The monitor is 15 feet long and, with a water supply of 3,800 gallons per second at 135 pounds pressure, throws a 5-inch jet with a muzzle velocity of 140 feet per second. It is operated by two 10-inch centrifugal pumps connected tandem with the outlet of one discharging into the suction of the other, and each operated by a 200 h. p. motor.

Water from the Mad river is supplied through a ditch M to a sump S, as shown in the plan and diagram. The pumps and motors located in the pump house D deliver through the high pressure pipe C to the monitor, which was first located at T and afterwards at U, successively excavating the slope up to the lines E, F, and G which is bounded its upper limits on May 1st, June 1st and July 1st, showing the relative progress of the work. The dotted line H indicates the possible limit of the borrow pit, which, being governed by the slope at which the excavated materials can be delivered by sluicing to the bottom of the pit at D, is determined by the height and horizontal distances, and provides for only a portion of the material required to complete the dam.

The minimum slope of the flume is governed by the maximum size of the stones carried through it, and in this case involved a grade of 3½ per cent for an open flume. As plenty of 15-inch steel dredge pipe was available, it was substituted for the ordinary open wooden box flume, reducing the frictional resistance to the water and permitting the development of pressure head in the lower part of the flume that enabled the outlet to be extended much farther than would have been the case with an open trough.

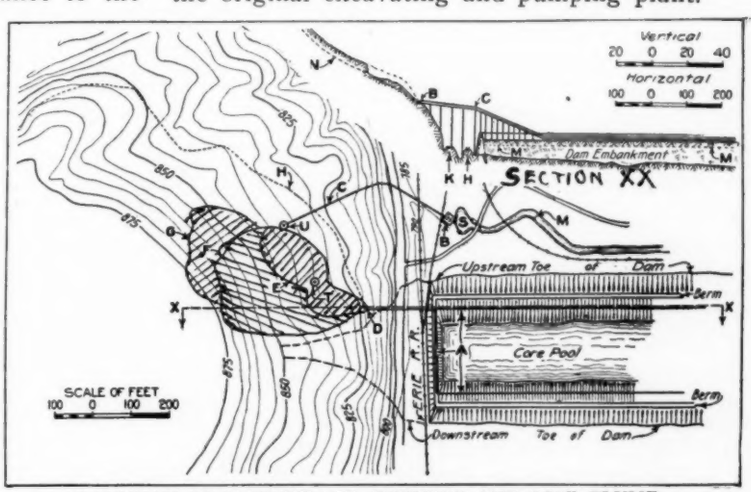
The flume commences at D at the bottom of the borrow pit and runs in a straight line over a low trestle to a convenient point on the dam, where it is connected with the U-shape distribution pipe that supplies both sides of the core pool. The minimum elevation of the upper end of the pipe was determined by the headway required above the Erie Railway H, and the highway K. This carried it well above the top of the adjacent cross dam protecting the railroad tracks, beyond which the slope is increased to 8 per cent, providing the required velocity and discharge through the horizontal distributing pipe.

This borrow pit contains a preponderance of fine material at one end and of coarse material at the other end. Where the material is about 80 per cent clay and the remainder sand and gravel, it can be transported through a flume with a grade of 1¾ per cent. In other places the proportion runs up to 25 per cent of clay and 75 per cent of sand and gravel up to 12-inches diameter and requires the 3½ per cent grade. All kinds of material are thus carried through the pipe, which is laid on the surface of the ground except where supported as shown on the trestle.

The excavation and transportation of material from the borrow pit requires the services of only five men—the pump man, the monitor man, a man at the flume inlet to keep it clear, and two men at the discharge end on the dam, except when additional help is required for a short time when it becomes necessary to move the monitor from one location to another.

The plant was put in operation about May 1st and has proved very efficient, requiring few shut-downs for repairs. The supply of fine material is satisfactory, as proved by the fact that a shut-down of 42 hours early in July only caused the pool level to be lowered about 2 inches while before the installation of the monitor and flume, a shut-down of only 13 hours lowered the pool 1.9 feet.

There has been no difficulty in maintaining the top of the core at its proper height relative to the sides of the dam since this apparatus was installed, and the material that it has handled has been put in position at about 48 per cent of the cost of placing material by the other method of excavating and pumping. Unfortunately there is not enough material available on the hillside to provide for the entire yardage necessary to complete the dam and it is therefore used only for the core construction, while the levees and beaches are built up with material provided by the original excavating and pumping plant.



LOCATION OF BORROW PIT, MONITOR AND PIPE FLUME FOR SLUICING FINE MATERIAL TO CORE POOL

This work is designed and supervised by the Miami Conservancy District, Arthur E Morgan, chief engineer, and Chas. H. Paul, assistant chief engineer. It is described in the Miami Conservancy Bulletin for August, from which our illustration is reproduced.

Improvement of Oswego's Water Supply

Report of expert engineers recommends modified lake intake, purification plant, extension of mains and other improvements.

The entire water works system and situation of Oswego, N. Y., have recently been studied by H. Malcolm Pirnie of the firm of Hazen, Whipple & Fuller of New York City, and a report with recommendations was submitted to the water department during the latter part of August on the basis of this. The water department has asked the common council to call a special taxpayers' election for the purpose of obtaining $90,358 for immediate necessary repairs to the water system.

The two most important changes needed in the plant are made necessary by damages to the intake, which extends for 8,700 feet into the lake to an intake crib in 76 feet of water; and by a river crossing, from leaks in which considerable water is escaping.

The intake pipe is reported to be broken off at a point 4,800 feet from shore where the water is only 37 feet deep, and where there is considerable danger and in fact certainty that sewage impurities from the river which flows into the lake will reach the intake and where also the water is warmer in summer than is desirable. Just how the intake came to be broken at this point is not definitely known, but the engineers believe it was caused by ice piling up at this point until it formed a solid mass to the bed of the lake and, moved by wind or current, carried the pipe with it, breaking it completely off at one point and opening up leaks at other points as well. It is found that the inshore 4,800 feet from the break to the pump well, is not tight and that 2 per cent of the supply enters through leaks in this distance. The temperature of the water occasionally rises to 70 degrees fahrenheit and the pollution is intermittently serious.

If all of the water could be drawn from the intake crib through a tight intake pipe, the physical properties would in general be excellent. Even then, however, there would be more or less danger of pollution from passing boats and other sources of pollution.

Chlorine is being applied to the water now, but the engineers recommend that an additional machine be provided at a cost of $1,000, that $1,200 be appropriated for a testing laboratory in order that the condition of the water may be kept track of continuously, and that $15,000 be spent in a rock fill for protecting the 4,800 feet of intake pipe from further damage. This is recommended only as a temporary remedy, and the city is urged to install a filtration plant as soon as it finds this practicable. Later, if it is thought worth while in order to obtain cooler water in summer, the outer section of the intake could be connected with the inner section, although such a repair made in deep water would be difficult and its permanency problematical. The cost of repairing the intake pipe would be about one-half the cost of filtration, providing that it was attempted to make the line only 90 per cent absolutely tight.

The consumption is considered to be excessive, being over 200 gallons per capita per day, due chiefly to leaking fixtures. It is recommended that all services be metered, including private fire lines. The engineers estimate that metering at a cost of $85,000 should be completed at once, but the department confines its request to $15,000 for fire line meters only.

A 20 inch river crossing is known to be leaking quite badly some 60 feet from the shore of the river, as indicated by an air test, but without dredging it was impossible to determine definitely the condition of the pipe at this point. The water department includes in its plan for immediate work a substitute bridge main with frost proofing and boxing at an estimated cost of $17,049.

In addition, it is proposed to reinforce the system of mains, especially by substituting larger mains for those which are 4 inches or less in diameter, at an estimated cost of $21,072; making improvements at the pumping plant at a cost of $4,500; reservoir fences costing $3,500, and contingencies estimated at $9,829.

The engineers estimate that a filtration plant would cost $327,000, exclusive of land, and that the estimated cost of all of the improvements recomended by them would be about $500,000.

Algae in Sacramento River

Citizens of Sacramento, Calif., have recently been noticing and objecting to a taste and odor in the water supply, which is obtained from the Sacramento river. C. G. Gillespie, of the filtration division of the city engineering department, has reported that the taste and odor are due to algae. It is a more or less common experience for various cities to be troubled with similar tastes and odors from algae growing in uncovered reservoirs, but it is not so common to have this trouble originate in rivers. Both Anabena and Diatoms have been found growing throughout almost the entire length of the Sacramento river, this being attributed to the long season of clear water which the river has experienced, combined with a seeding of the river by some returned drainage from rice lands and irrigated areas.

The department proposes filtration and aeration for removing the odors and tastes as well as for purifying the water, it being suggested that incidentally the aeration by spraying will have a decided cooling effect on the water.

Designing Aqueduct of Winnipeg Water Works*

By James H. Fuertes

Studies of soil conditions and of special designs of inverts to meet the various conditions; the formation and repairing of settlement cracks, and the water-tightness and cost of repaired work.

DESIGNS OF INVERTS: FOUNDATION CONDITIONS

In the design of the inverts for the different sections of the aqueduct it was, of course, recognized that the soil to be expected in the trench bottoms would vary from a semi-fluid mud to solid rock. A large percentage of the total was of boulder-clay, hardpan, gravel, and rock, or of soft soil on top of solid materials above described. The first twenty miles, however, was through a prairie country, the soil of which was clay deposited from sea water ages ago and practically devoid of silt or ganular materials. This clay, however, is underlaid with a layer of gravel and boulders resting on the limestone rock some 40 feet or more below the surface.

This soil is very peculiar and uncertain in its action under loads, and many serious structural accidents have occurred in Winnipeg and vicinity as a result. Its compressibility is variable, depending on its depth below the surface and on its water contents. It appears that this variability is due, in part, to the action of frost when leaving the ground, and to drainage and evaporation of its water content during the dry summer weather. Frost appears to pulverize and loosen up the soil for a certain variable depth; drying cracks it open, sometimes to a depth of a few inches, in little blocks, hard in themselves, but resting on a softer base. Further drying, particularly if covered with humus or soil, sometimes opens up long continuous cracks often up to three inches in width at the surface, and extending down several feet. When in this condition, a rain will fill these cracks, cause the ground to swell, imprison the water in its mass and force it into the lower strata, maintaining these, more or less continuously, in a condition of semi-fluidity. Often there may be a mat, or raft, of dry soil on the surface, many feet in thickness, resting on lower strata in a state of saturation.

Soil tests taken from a dressed surface, which has had a day or two to dry, may sometimes give bearing values high enough to satisfy any reasonable foundation requirement. The same soil, under other conditions as to moisture, will flow under pressure like putty. But its worst feature is the condition of continuous, progressive settlement under a constant load, and greater relative settlements in smaller than in greater depths below the natural surface, under the same load.

* *Continued from page 222.*

COMPRESSIBILITY OF CLAY SOIL AT MILE 13

This is shown in tests made at Mile 13 (Deacon) in April 1916, and abstracted in the following table:

Depth of test area below natural surface	LOAD PER SQ. FOOT, 3,000 POUNDS Total Settlement in Feet at End of Day No.												
	1	2	3	4	5	6	7	8	9	10	11	12	13
4 feet	.023	.024	.025	.028	.028	.028	.031	.032	.032	.032	.032	.032	.032
5 feet	.027	.021	.029	.029	.030	.030	.032	.024	.035	.035	.035	.035	.035
7 feet	.017	.018	.018	.019	.020	.020	.020	.021	.021	.021	.021	.021	.021

Depth of test area below natural surface	LOAD PER SQ. FOOT, 6,000 POUNDS Total Settlement in Feet at End of Day No.												
	1	2	3	4	5	6	7	8	9	10	11	12	13
4 feet	.077	.090	.098	.101	.103	.103	.103	.103	.103	.103	.103	.103	.103
5 feet	.076	.079	.081	.081	.082	.083	.084	.086	.086	.086	.086	.086	.086
7 feet	.030	.031	.032	.033	.034	.035	.035	.035	.036	.037	.037	.037	.037

From the above it is seen that doubling the load per square foot at a depth of 4 feet caused 3¼ times the settlement; doubling the load at 5 feet 2¾ times the settlement; and doubling it at 7 feet depth caused a settlement of 1¾ times that under the original load; also, that in all the holes and at all loads the settlement at the end of two weeks was about 1¼ times the amount at the end of the first day.

Repetitions of tests at other times showed this same general condition but never just the same total amounts. In all the above tests the ground was free from frost at the depths tested, but was moist, and in its natural condition for that season of the year. On the surface, when dry, this soil would be as hard as a good road surface, and could be marked with the heel only with difficulty.

VARIABILITY IN BEARING POWER

This variability in compressibility introduced conditions making it impossible to build on it any continuous structure that would be free from cracks when finished. The variable depth of excavation alone would produce this, as, the weight of the structure being the same, the varying compressibility of the soil at the different depths disclosed in building an aqueduct on a uniform grade would alone cause a wave to travel lengthwise of the aqueduct, as the backfilling progressed, resulting in transverse cracks and being a factor in the production of the longitudinal cracks. No cracks appeared in the aqueduct, either invert or arch, except under the weight of the backfill or the action of frost on unprotected work. Generally none showed with backfills of two feet or less.

These conditions were foreseen and fully weighed before proceeding with the design and

construction of the inverts. Cracks were expected in this part of the work.

Further east, soft bottom was known to exist also in a number of locations of short lengths. These were, during construction of the work, either entirely dug out and refilled with water-settled sand and gravel fills, or else rolled embankments or pile foundations were used. A very few unimportant cracks occurred in the inverts in a few localities so treated.

SPECIAL INVERTS FOR VARYING CONDITIONS

In some places, particularly where roads and railroads crossed the aqueduct, the section was thickened and reinforced with steel bars to distribute the weight more uniformly over the entire width of the base, to prevent excessive local settlement.

Also, where ground water levels were so high as to tend to float the aqueduct, when empty, and where the backfilling materials were very light in weight, the aqueduct bottom was thickened sufficiently to add weight enough to resist flotation of the tube, and the bottom and arch reinforced, as required, against water pressure from without and within, as well as for backfill loads.

All these contingencies were foreseen and provided for in the preliminary estimates of cost. No special allowance, however, was made in these estimates for pile foundations, or other means to secure a rigid foundation for the work, through the prairie section above referred to, as it was the judgment of the engineers making the original report that this would not be necessary.

SETTLEMENT CRACKS

As a matter of fact, troubles from settlement had occurred only in about 1.6 of the 20 miles of contract 30 of this treacherous country; 0.45 miles of the 17¾ miles of contract 31, 0.2 of a mile of the 18.2 of contract 32; about 0.2 of the 16.1 of contract 33, and about 0.02 of a mile of the 13 miles of contract 34, by September, 1916, practically all the cracks having been in the 1915 works.

This date is given because subsequently a much more expensive form of construction was adopted to prevent such cracks, the changes consisting of using 8-inch extensions, or footings, on the edges of the invert, to reduce the maximum pressures to lower amounts on poor foundations, and using a heavy thicker invert, reinforced with steel, where the ground was less hard than the best.

REPAIRING CRACKS

None of the work above referred to as creacked was taken out or replaced. Most of it was repaired by cutting out the cracks to a width of about half an inch for a depth of 2 inches and packing the cracks with hammer-caulked neat portland cement, put in very dry and tamped very solidly, first washing all loose chips, sand and dust out of the prepared cracks with water under pressure.

This method of repair made a very strong tight joint; in fact the edges of the crack were knit together as strongly as though they had never been broken. Several sections of invert, including portions of these joints, have been cut out and tested. The cement filling, even after having been in place only two or three days, adheres so strongly to the concrete that when broken the break was generally in the old concrete, sometimes in the filling, but never at the junction of the two.

WATER TIGHTNESS OF REPAIRED WORK

Also, to test the tightness of the aquduct after repair, a number of sections were selected and tested; one of these, 270 feet long, was purposely picked out to include the most seriously damaged portion. In this section the invert had several longitudinal cracks, some open ½ inch at the surface, others of smaller widths, and the arch was cracked along the haunch on one side as well as along the top.

Bulkheads were built at each end of their section, which was then filled with water to the level corresponding to a rate of discharge of 85 million gallons per day. Daily records were kept of the drop in water level for some months and the rate of leakage was found to be less than 5,000 gallons per mile of aqueduct per day, which for this size of aquqeduct, equivalent to a circle 8.1 feet diameter, would hardly be called excessive for a cast iron pipe line with caulked joints. The average of the other tests gave a leakage of about one-third that amount.

COST OF REPAIRS

The actual cost of repairs of the 5,300 feet repaired, including labor, materials and incidentals, was less than half a dollar per foot of aqueduct repaired; in fact, about $2,500 in all.

With the greater experience gained both by the engineers and inspectors and by the contractors' men in securing more thoroughly compacted foundations, particularly along the sides of the inverts, practically all invert cracks could have been eliminated in future work without the use of heavy reinforced inverts.

(To Be Continued)

Automobile Revenue for Highway

That motor vehicles pay handsomely towards the construction and maintenance of highways is the opinion of R. E. Fulton president of the International Motor Company, manufacturers of Mack trucks. He estimates that in 1918, motor vehicles and their manufacturers paid respectively $150,000,000 and $33,000,000 in taxes, for licenses and for other government and municipal charges, which amounts to a total of about $25 for every car built.

Out of 2,500,000 miles of highway in the United States, only 6,250 miles are said to be satisfactory for heavy-duty traffic, and for this amount of improved roadway, the motor vehicles pay at the rate, if all their revenue was concentrated on it, of $24,000 per mile per year, while their actual payments amount to $75 per mile for every mile of highway, good and bad, in the country.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 West 39th Street, New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba.....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western Office: Monadnock Block, Chicago

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FRANK W. SKINNER, Associate Editor

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SEPTEMBER 11, 1920

Quicksand Methods

Much of the distrust that is often felt for construction work below ground level is due to the general fear of quicksand in making and maintaining excavations. Although it may be, and frequently is, a serious menace, it is often not so bad as feared, and under most conditions may be controlled and the work safely executed although perhaps at an increased expenditure of time and labor.

Quicksand is at its worse when encountered in large quantities in an excavation below, and especially immediately adjacent to, the foundations of existing important structures. Given proper experience and equipment, even this condition may be successfully handled, as has been demonstrated abundantly by foundation work in New York City where excavations have safely been made 100 feet below the surface in quicksand beds underlying the foundations of adjacent lofty buildings. In these cases, where depth and dimensions were extreme, pneumatic caissons have generally been found necessary and satisfactory often less elaborate and expensive methods serve even for large work and great depth, and since quicksand affords a satisfactory foundation when permanently and reliably confined, it sometimes suffices merely to carry the excavation below the probability of future adjacent excavations.

For isolated work where plenty of time and abundant equipment is available, the construction can usually be carried out by one or another of various methods, provided sufficient care, patience, and good judgment are exercised. Of course, with important work or where the difficulties are unusually great, expert engineers and contractors, experienced in such construction, should be employed or consulted.

For many kinds of work in which quicksand is incidentially encountered and no great depth or mass is involved, the difficulties can generally be overcome by simple methods selected or modified with good judgment and ingenuity, and the resolute, resourceful contractor need not have much fear or sustain very much loss.

In such cases the quicksand can generally be dealt with by confining it, draining it, maintaining equilibrium of pressure, or by executing the work in small units and with great rapidity. Practical operations for an assumed case of this sort are suggested on page 239.

When quicksand can be thoroughly drained, it ceases to be quicksand, and becomes one of the easiest instead of one of the most difficult substances to handle. If it cannot be successfully drained, it may be counter-balanced or handled in very small quantities and increased rapidity that permits it to be removed and permanently confined by successive small increments. Numberless variations of the details by which the work may be executed have been developed and can be still farther multiplied, always affording a fertile field for ingenuity, good judgment and economy.

The Cost of High Wages

An accurate measure of the cost of increased wages is afforded by the statement in the August Mid-Month Review of Business issued by the Irving National Bank of New York to the effect that the wage increases just granted to railroad employes by the Railroad Labor Board, will aggregate $626,000,000 a year, and, coming on top of many previous increases, makes the total annual railroad payroll $3,600,000,000, an amount more than twice as great as was required for the same purpose in 1916 when the railroad service was much better.

This is entirely consistent with the well known principle that increasing labor wages to an unusual amount or to a degree enabling the laborers to remain idle part of the time, greatly decreases their efficiency. Nearly or quite all of the large employers recently questioned in this matter agree that the cost of executing given units of some kinds of construction work is now four times or more as great as it was six years ago, the inevitable result of increasing wages 100 per cent or more, usually more, accompanied by the almost universal decrease of efficiency by 50 per cent or more. This does not take in consideration the much larger amount of time lost, nor the dissatisfaction, unreliability, and greatly increased turn-over of labor.

Good Roads Expenditures in 1919

According to a report by the Bureau of Census entitled "Financial Statistics of States—1919" soon to be issued, of the $71,320,765 representing outlays for all permanent improvements by the forty-eight states, a little more than one-third, or $23,845,093, was expended for the construction of new roads and the permanent improvement of existing ones. In addition, $24,180,975 was apportioned by the states to their counties, municipalities, and other minor civil divisions for use in the construction, improvement and maintenance of roads, and a considerable portion of this sum was employed in construction and permanent improvement.

The greatest outlays for roads by individual states were reported as follows: California, $4,891,094; Ohio, $2,721,708; New York, $2,411,690; Oregon, $2,163,479; Pennsylvania, $2,126,442; Michigan, $1,753,883; Utah, $1,262,282; Maryland, $1,101,556.

Only twenty-eight states expended money directly on the construction and improvement of roads during the fiscal year, but a number of others apportioned sums to counties, municipalities, etc., which was spent in the construction and improvement of roads. Seven states, however, reported neither outlays nor apportionments for these purposes.

During the year the net indebtedness increased 3.5 per cent and the per capita net indebtedness increased 1.9 per cent, averaging all of the states. During the same year the total value of public properties increased by 3.3 per cent and the per capita value by 1.6 per cent.

Dock and Warehouse for San Francisco

San Francisco is planning a system of ship, rail and warehouse facilities on the water front estimated to cost $2,300,000, the plans having been adopted by the State Board of Harbor Commissioners in the latter part of August. The president of the board, John H. McCallum, says that the project is superior to anything existing in the United States and that it will provide facilities for handling all cargoes of grain, cotton, seasonal fruit and tropical products at a minimum cost. Dockage will be provided for the largest ships. The warehouse will be the first multiple-story dock warehouse on the Pacific coast. It will be six stories high, 816 feet long and will provide storage capacity for 40,000 tons of freight.

Riverside Flooded by Rains

Riverside, N. J., has found its business center flooded several times recently owing to the unusually heavy and frequent rainfalls during the first three weeks of August. Shoppers and theatre patrons have found themselves marooned in stores and theatres after several downpours, with no method of escape except by wading through a considerable depth of water or the use of taxicabs. During one storm, water rose a foot above the floor of a restaurant, to the great discomfort of the patrons.

The trouble is said to be caused by the fact that the storm sewer draining the central part of the town is entirely too small and the township authorities have instructed engineers to have work begun on a new sewer at the earliest possible date.

For a Boston-Fall River Canal

Some years ago it was proposed to build a canal from Fall River to Boston, utilizing the Taunton river as a part of the route. The Taunton delegates to the October meeting of the Atlantic Waterways Association will urge this project, or at least a widening and deepening of the channel of the Taunton river, giving 100 foot width and 12 feet depth at low water.

This improving of the Taunton river was estimater to cost $534,000 when approved some years ago by the War Department, but would probably cost more now. The cost of the entire project from Fall river to Boston would run up into the millions but it was cleaimed that it would be of great benefit to the eastern part of New England. If the Taunton river part of the project is put through, it is proposed to transport goods from Taunton to the Great Lakes by water, using the Taunton river, Narragansett Bay, Long Island Sound, the Hudson river and the Erie Canal. Although the route is longer than by rail, it is cleaimed that the rates of freight transportation would be considerably lower and the time not much greater than rail transportation has required during the past few years.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

Excavating Foundation Pit in Quicksand

Methods frequently successful with limited deposits of quicksand or for pits of moderate dimensions.

In making excavations for foundations such as bridge piers, retaining walls, power stations, water works and sewer plants, or trenches for sewer, gas and watermains, deposits of quicksand are sometimes encountered that, unless properly handled, are likely to cause serious trouble to the contractor.

If the excavation is very deep, if there is a large mass of quicksand, if the work is otherwise delicate or of great importance, or if adjacent structures are likely to be endangered, thorough preliminary investigation should be made and the work should be planned and executed under the direction of an engineer experienced in similar work.

When the excavation is independent of existing structures and is of moderate dimensions, as for example, for land piers and abutments of small highway bridges, foundation piers, in wells, shafts, or for short sections of trenches, it may often be successfully performed with simple equipment and ordinary methods provided in advance or selected as required by the development of the work, if the latter is carefully and conservatively handled by an experienced ingenious man even though he has not previous familiarity with quicksand.

TYPICAL CASE

What is a safe and economical way to complete, in quicksand, the excavation of a pit 12 feet deep for a bridge pier with an 8x26-foot footing? The pier is assumed to be for the approach span of a light steel truss highway bridge and is located on level ground, about 2 feet above water level and 50 feet from the shore line of a small river not likely to flood during the progress of the work.

Consider that about 2 feet of fine black loam was excavated with scrapers down to a bed of sand with some clay and gravel that extends to a depth of 6 feet below the surface; that the sand is hard and solid and stands up with a vertical face in the upper part, but below the groundwater line, about 3 feet below the surface, it is very wet and caves in with the flow of water; that this sand was excavated by hand without great difficulty to a depth of about 2 feet; that the trouble from the water became worse requiring two hand pumps and later a 3-inch gasoline pump that managed to keep the water down; and that the sides were faced with braced sheeting boards.

Assume also that at the depth of 6 feet below the surface, the sand is very fine, wet and of a greasy feeling, and flows into the excavation as fast as it can be dug out. If a small hole is excavated a foot or two below the surface of the sand, it will immediately fill with water and the sand will boil up in the bottom, soon rising to the original surface. The top of the sand is so soft that the men sink into it as in mud, and excavation has been suspended.

This quicksand may perhaps be part of the former bed of the river, and can probably be excavated without serious difficulty or great expense. Possibly the stratum may be only 2 or 3 feet deep, in which case it can be easily handled. If it is much deeper it will take more time and trouble, and if it is very deep it will require slow and careful work that, however, should be managed without very great difficulty for the maximum depth of 6 feet here required.

EXPLORATION

The first thing to do is to determine, if possible, the depth of the quicksand, which may or may not be easily accomplished. If it is shallow and underlaid by a stratum of gravel, hard sand, clay or other hard material, indications will be secured by soundings with a ¾-inch steel rod or its equivalent, driven down a few feet which will show clearly when it reaches hard bottom. If this is found to be at about the same elevation all over the excavation, it will show the limit of the quicksand well enough, but if it does not encounter resistance or obstruction, the quicksand may extend to a still greater depth or it may, without being apparent, change at any point to sand that is not quicksand.

If this is uncertain, better indications may be obtained by driving down a good-size steel pipe, say 4 inches in diameter, and excavating the interior with a spoon, small scoop, or bag on the end of a pole, thus bringing up samples that will show the character of the soil to as great a depth as the pipe can be driven and excavated. Driving this pipe or even a larger one will also be useful in providing a sump through which to pump

down the ground water.

SHEETING AND DRAINING

If hard bottom is found within 10 or 15 feet of the top of the quicksand, the pit should be protected by a continuous wall of sheet piles driven completely around it and reaching down to penetrate the hard stratum if possible. This sheeting must be as nearly water-tight as possible, and may be temporary or permanent and of wood or steel according to the contractor's facilities and the estimated final cost and salvage. Light steel piles will drive easier, make a tighter wall, and have greater salvage than wood. They can be driven with a light air hammer or a drop hammer. Wooden sheeting probably cannot be driven with as light a hammer as will suffice for the steel and probably cannot be pulled and redriven or salvaged to as good advantage, if at all.

If the piles are carefully driven and penetrate to hard bottom, it will probably be possible to lower the ground-water level by pumping from one or more sumps so that the quicksand can be excavated to subgrade without great difficulty. In some instances this may even be acomplished without sheeting but is likely to be very slow and expensive. If the leakage through the sheeting is great, it will be better to make the excavation in several transverse sections, each carried down to the required depth before the next is commenced; and in each, stop the leaks by patching, plugging, puddling, etc., as they are exposed.

SECTIONAL EXCAVATION AND CONCRETING

If the sheeting is not driven to hard stratum, or if the pumping does not dry out the quicksand and the bottom boils up badly, it will probably be best to make the excavation in very small successive sections, completing each and sealing the bottom with concrete before commencing the adjacent one.

This substantially amounts to sinking a number of separate pits, from 3 to 6 feet wide according to conditions and the convenience of the men. Each pit should be enclosed temporarily with sheeting driven down by hand if more convenient, and kept a little below the bottom of the excavation as the work progresses, and should be drained by pumping through a sump or a well point driven in one corner.

By rapid, continuous work of two or three men over a small area thus protected, the small pit can be carried down 6 feet and must immediately be sealed by covering the bottom with concrete thick enough to have sufficient weight to overcome the upward pressure and hold the quicksand down. If this is not practicable, the concrete should be at least 12 or 18 inches in thickness and may have inserted a short length of old pipe reaching through the quicksand and projecting vertically above ground water level to relieve the pressure. After the concrete has been deposited, the water should not be pumped out of the pit until the entire excavation has been completed. After the completion of one pit, another may be excavated and concreted in the same way, and so on, until the entire excavation is finished, two or more gangs working simultaneously on different pits if necessary. After the excavation has been finished it should be pumped out, and the vent pipes, if any, cut off and securely plugged. The remainder of the footing may then be concreted in the dry, and the sheet piles salvaged or left permanently in position.

New York Buys Motor Trucks by the Hundred

Two hundred and twelve motor trucks and seventy-five motor flushing machines for the Department of Street Cleaning.

New York City on August 20 received bids for 212 gasoline trucks and 75 motor-driven street flushers, and awarded the contract a few days later to The White Company. The contract price for the trucks without flushing equipment was $1,215,790.55.

The specifications call for gasoline motor-driven trucks with four wheels, rear wheel drive, front wheel stear, engine under hood, to be used by the Department of Street Cleaning. The body to be a back dumper of steel construction with a capacity of 162 cubic feet (water level measurement), operated by power hoist. The truck to be nominally of 5 tons capacity. No manufacturers were allowed to bid who had not been engaged in the manufacture of motor trucks and motors for trucks for at least eight years or which did not have at least 100 of its make of chassis of 5 tons or greater capacity in operation in the United States, each of which had given at least 75,000 miles of service. Moreover, the company must have had in operation for at least six months prior to the time of bidding and still have a service station within 15 miles of the Manhattan Municipal building equipped with spare parts for 5-ton trucks, at which stations are inspectors for the purpose of inspecting, at regular periods, chassis which are in operation in this vicinity.

The engine was required to be a 4-cylinder, 4-cycle engine which will develop not less than 35 brake h.p. at governed speed, suspended at three points. The specifications described in detail the requirements of all features of the engine and chassis. As an illustration: "Front axles and rear axles shall be of carbon or alloy steel, suitably heat treated, and shall have minimum physical characteristics as follows: elastic limit 60,000 pounds per square inch; ultimate strength, 80,000 pounds per square inch; elongation, 16 per cent; reduction of area, 45 per cent; Brinell hardness, 200."

The wheels were required to be of steel disc type or steel spoke type; the tires single 36x6 front and not less than dual 36x6 rear, to be of high profile, solid base, pressed-on type.

The dumping body is to be built throughout of steel not less than 3-16 inch thick, so designed

that it and the hoist may be easily dismounted so that the chassis may be used for carrying a flushing equipment. The body is to be designed for side loading with ash cans and provided with 6-inch hinged sides, the hinges being so placed that when the sides are down they will not interfere with the rolling of ash cans. When the hinged sides are up, the loading height over the rear wheels must not exceed 63 inches when the truck is loaded with 10,000 pounds. The body is not to exceed 86 inches in side measurement. The body is to be so constructed that it will carry 10 cubic feet of water without reaching the bottom edge of the tail gate. The tail gate shall be tight closing and operated from the driver's cab. The body must dump to an angle of not less than 45 degrees from the horizontal. There will be suitable metal rings or eyelets along the sides and ends of the body by which to fasten on a canvas cover.

Each truck has a dash bracket for attaching a standard push snow plow. The truck is fitted with four shovel racks or hooks.

The completed truck will be required to show its ability to travel with a load of 10,500 pounds and with the additional weight of a driver and one other man, over a specified route which is approximately 14 miles long and includes several severe grades, the steepest of which averages 9.8 per cent for 2,000 feet, making the run in 90 minutes without excessive heating in any part and without showing evidence of weakness. In addition, each chassis and dumping body and equipment will be tested on house-to-house collection for a period of not more than 6 days, including the carrying and dumping of 7 tons of sand without showing evidence of weakness. The manufacturer must guarantee that, for a period of one year, he will replace all broken parts and make all repairs that may be required or made necessary by reason of defective design, materials or workmanship, without any cost to the city.

In addition to the truck, 75 flushing equipments were called for, there being two alternate bids, one for "flushing equipments complete, based upon driving the pump with power taken from the truck engine, or, by means of a separate motor. Any bids made under this alternate must be based upon furnishing the latest and most improved type of engine, pump and equipment complete used by the manufacturer of the flushing equipments." In either case, the flushing equipments must be so designed that they can be removed and replaced by the dumping body, or vice versa. The former of these alternatives was the one contracted for.

The water tank is to be an oval tank with a capacity of not less than 1,200 gallons, with at least two baffle plates, suitably supported on cradles attached to the frame of the chassis. It shall be of not less than No. 7 U. S. Standard gauge and withstand a static pressure test of 45 pounds. The pumps must be capable of delivering 350 gallons per minute with 35 pounds pressure at the flushing nozzle when the motor is running at its governed speed. Four power flushing nozzles and 2 sprinkler heads will be furnished in suitable locations, the flushing nozzles being "so arranged as to discharge water on the street at an angle which will effectively clean all classes of street pavements now in use in the city of New York and the stream shall be effective for a distance of 6 feet with two nozzles operating in the same direction." All levers for control of nozzles and sprinkling heads will be located convenient to the driver of the truck so that one man may both drive and operate the machine. Each nozzle and sprinkling head will be provided with a separate control.

Immigration Notes

International Labor Office

Under the terms of the treaty of Versailles, the International Labor Office is under the control of a governing body of twelve members representing Belgium, Germany, Switzerland, Spain, Argentina, Canada and Denmark, six members elected by delegates to the International Labor Conference held in Washington, November, 1919, and six delegates representing employers.

At present the International Labor Office is divided into two principal divisions, diplomatic and scientific. The diplomatic division will negotiate with the different governments, employers' organizations and trade unions for the ratification of the conventions adopted by the International Labor Conference, the most important of which are the six that were adopted at Washington and which limit the hours of work in industrial undertakings to 8 in the day and 48 in the week. The scientific division will collect information on the social and economic problems of the world and publish it.

There are also six technical sections, employment, seamen, agriculture, Russian inquiry, social insurance co-operation, and emigration. The emigration and employment sections are co-operating with the International Immigration Committee on the problem of reciprocity of treatment of worker immigrants. A commission has been appointed to report measures adapted to regulate the migration of workers out of their own states and to protect the interest of wage earners residing in states other than their own.

It is reported that on account of strikes in the mining districts of Salamanca, Spain, large parties of workmen have decided to leave the country and that many of them will come to the United States. In a village in the province of Guadalajara, every male adult, except the mayor who is aged, has decided to emigrate to the United States, and will soon be followed by their families.

Dispatches from Danzig state that there are now in that city at least 50,000 Jews ready and waiting to immigrate to the United States.

During the week ending August 28th, 80,690 aliens arrived at the port of New York and on August 28th, all records were broken by the inspection of 15,438 immigrants at Ellis Island while 3,253 were still awaiting inspection. Commissioner of Immigration Wallace, who has often been quoted as expressing his opinion to the effect that great numbers of immigrants are waiting to come from Europe and that it is only a question of enough ships to bring them here, added to it, that from information received from many ship's agents, he believed that a still greater number of immigrants would arrive on the week ending September 4th, during which several big steerage carrying vessels were due to arrive and were coming fully loaded.

That efficiency and production depend on able management as well as on the work, was emphatically stated by Mr. C. S. Bundesman, superintendant of the piece work department at Hog Island, who states that through his experience with more than 200,000 men, he believes that production requires enthusiasm, and if the proper interest is developed, and labor properly directed and compensated, construction can be increased 50 per cent or more.

He said that before putting into effect at Hog Island, a system of profit sharing, the average cost for labor alone of electrical installation on a ship was from $17,000 to $35,000 and that within a month after profit sharing began, the average cost for this work dropped to $4,000 and has remained there ever since.

Cinder Concrete Blocks for Walls and Pavements

The U. S. Counsul, S. P. Forbus at Brest, France, reports the resumption there of the war suspended business of making concrete blocks with cement and crushed cinders.

These are specially used in pavements, walls, cellar floors and for general construction purposes for which they are cheaper than clay bricks. Interior plaster and exterior stucco adhere well to them, and in the vicinity of Brest they are especially valuable for their resistance to the great humidity that causes brick walls there to drip condensation water.

State and Government Clash Concerning Road Employees

Under the statutes, the Fiscal Court of any county in Alabama may empower overseers of road work to summon any citizens of a county to do road repair work, except citizens of incorporated cities and clergymen. The men cannot be required to work more than two days in one week or six days in one year except in cases of emergency. They are paid at the rate of $2.50 a day, or the work may be accepted in payment of taxes.

A short time ago seven civilian employees of Camp Henry Knox were summoned by the officials of Meade county to leave work at the camp and perform road work. The military authorities contended that the men, being government employees, were exempt from working on county roads. The respective rights of the military authorities and the state in this matter are to be decided by the courts.

Expediting Transportation of Construction Materials

An important help for contractors who are suffering from delayed shipments that are not relieved by ordinary efforts has been provided by the co-ordination of representative construction and material men with the railway leaders.

At the suggestion of Mr. Daniel H. Willard, chairman of the Advisory Council of the Association of Railway Executives, made to Hon. William N. Calder, chairman of the Special Senate Committee on Reconstruction and Production, during his testimony, a committee of representatives of the construction industry in Greater New York has been organized for the purpose of acting directly with the association of Railway Executives in securing the prompt movement of construction material essential to the public interest.

It is believed the work of this committee will go far towards relieving the acute housing shortage in Greater New York. The committee consists of the following:

Dr. J. T. Duryea, president of Pierce, Butler & Pierce Manufacturing Corporation, Chairman; J. H. Burton, president of J. H. Burton Lumber Company; James C. Ewing, president of Goodwin-Gallagher Sand and Gravel Company; J. Sherlock Davis, president of Cross, Austin & Ireland Lumber Company; F. L. Cranford, contractor; C. J. Curtin, president of the Farnam Cheshire Lime Company; T. N. Gilmore, vice-president of the Dwight P. Robinson Company; Calvin Tomkins, President of the Tomkins-Cove Stone Company; C. A. Crane, Secretary Contractors' Association; Ronald Taylor, president Ronald Taylor Company. Headquarters at Room 1605, 29 West 39th Street. Telephone, Vanderbilt 4600.

The committee is prepared to receive applications for assistance in expediting the movement of construction materials from point of origin to destination, in cases where the ordinary routine methods have failed, and where the public interest is at stake.

The committee especially requests that applications be made to it only after the usual methods have failed to produce desired result. The suggestion of the organization of this committee by Mr. Willard indicates the determination on the part of the carriers to use the present facilities of the railroads as far as possible to relieve cases where the emergency is greatest. The committee requests the co-operation of associations and trade journals connected with the construction industry.

John George Leyner

(There are few if any engineers who are so well qualified as W. L. Saunders to understand and appreciate the high character and great engineering and commercial achievements of J. G. Leyner. The following appreciation has been condensed from a memoir prepared from Mr. Saunders' personal knowledge of Mr. Leyner's career and is as inspiring as authoritative.)

John George Leyner, of Denver, Colo., was killed by an automobile accident near Denver on August 5, 1920. Mr. Leyner was an American genius of exceptional ability, a pioneer in rock drilling and mining appliances and an inventor who has contributed much to the industrial progress of his age. No man, in fact, has done as much in the past generation to advance the art of removing rock. Through his inventions the rock drill has passed from the percussive stage, involving machinery of heavy weights, where the rock drill has become a thing but little larger than a pneumatic tool.

To make a rock drill on the piston plan and reduce its weight to a point consistent with practical handling in mines and stopes, to simplify it in its mechanism, and to make it stand up against hard usage, were problems that taxed the best energies of inventors between 1870 and 1900. Henry C. Sergeant came to the front and is the recognized leader in the perfection of the piston type of drill.

Mr. Leyner was the first to attack this system. . . . He advocated and patented the use of the piston as a hammer only, to strike the end of the steel or an intervening medium connected with the steel. He introduced a water jet through the piston into a bit for clearing the hole cuttings. His system patent was taken out in 1903 and his method patent in 1904.

Incorporating the Leyner Engineering Works in 1902, Mr. Leyner built shops at Littleton, Colorado, soon thereafter. Engaged in developing a new and radical principle, he encountered many obstacles, mechanical and financial. . . . For a period of 12 years, in spite of difficulties and successful attacks made upon his drill by the old and leading companies — The Ingersoll-Sergeant Drill Company and the Rand Drill Company, Leyner stuck to his guns, until in 1911 the Ingersoll-Rand Company took over all his patents and inventions, transferred the manufacture to their works at Phillipsburg, and the Leyner-Ingersoll type of drill was from that time a standard. . . . The "Jackhammer," which might almost be placed in one's overcoat pocket, is built on the Leyner principle. This is the most generally used rock drill of today, not only in America but throughout the world. The water Leyner, now known as the Leyner-Ingersoll, is now widely used, displacing entirely the old piston type of drill for mining and tunneling. It holds the world record for fast tunnel driving.

Leyner's other inventions include the drill sharpener, now recognized as the simplest form of sharpener and the one most widely used throughout the world. It has been estimated that this sharpener is used for sharpening about 90 per cent of all the machine-sharpened steel in the world. Leyner also invented the "Little Tugger" hoist used in mines and ship yards. He built the original machines used for producing shredded wheat. His latest invention is the "Linapede" or Leyner Farm Tractor. He was engaged in the development of this tractor at the time of his death.

Mr. Leyner was born in Boulder county, Colorado, in 1860, being the first white child born in that county. He was the son of Mr. and Mrs. Peter A Leyner. He leaves a widow and three adopted children.

A product of the great West, Leyner was a man of strong physique, a worker with his hands and his head, . . . Like most inventors, his main strength was mechanical, though unlike most inventors his vision was laid on practical lines and in advance of conventional things.

The mining industry owes much to Leyner's genius, the world much to the mining industry. To have reduced the cost of removing rock and ore, as Mr. Leyner has done, is an achievement which should place him at the front among America's great inventors.

Chicago's Street Traffic and Pavements

The city council of Chicago has appointed a committee with Alderman Oscar Olsen as chairman to consider what can be done to prevent the destruction of the city's pavement by traffic. Mr. Olsen is quoted as saying that heavy trucks are ruining the streets of the city and that thousands of dollars of damage is being done by them every day. He states that the question to be solved is whether Chicago should "take a backward step by legislating these heavy vehicles from the streets. Would such a stand be a good one for the city to take? Progress demands these rapidly travelling and heavy-capacity vehicles.—Instead of driving them from our streets, should we not rather decide on a more up-to-date and comprehensive plan of future street building that will make our thoroughfares sufficiently strong to withstand the strain of these heavy vehicles?" He believes that the present-day heavy vehicle traffic is reducing the life of the city's pavements by more than 50 per cent. One street is cited which was paved with a surface that was expected to have a life of at least ten years but which was practically destroyed in two years.

Under such conditions, it is of course imperative that something be done. We suggest whether, in adapting pavements to this heavy truck traffic, the trucks should not at the same time be required to confine themselves to the use of certain designated thoroughfares in order that the heavier and consequently more expensive pavement may be confined to these thoroughfares. If this could be done it would probably reduce the number of streets which must receive the heavy pavement by at least 75 per cent.

The preparation of a city plan for Dubuque, Iowa, is urged by city manager O. E. Carr, mayor James Alderson, and commissioner Louis Brede.

Recent Legal Decisions

CONTRACTOR ON COST PLUS MUST EXERCISE GOOD FAITH

The New York Appellate Division holds, Title Guarantee & Trust Co. v. Pam, 182 N. Y. Supp. 824, that a contract to do work upon a basis of cost plus a stipulated commission; does not mean that the contractor has a right to expend any amount of money he may see fit upon the work, regardless of the property, necessity, or honesty of the expenditure, and then compel repayment by the other party, who has confided in his integrity, ability and industry. While statements as presented by the contractor may make out a prima facie case of its right to recover the amount shown thereby, accompanied by vouchers and proof of payment, proof may be introduced to completely destroy the value of the statements and vouchers and open the question as to what was the real cost of the work, honestly, efficiently, and properly done. In an action on notes for work done, given to a contractor under an agreement that there should be no waiver of the maker's right to investigate, and that overcharges should be deducted, the evidence was held to establish reckless and fraudulent expenditures by the contractor's employees, and that the reasonable value of the work was approximately $70,000, instead of about $130,000, as claimed by the contractor and therefore the defendant was entitled to a deduction of about $50,000.

SURETY LIABLE TO CONTRACTOR FOR LACK OF REASONABLE CARE TO MIMIMIZE COST OF COMPLETING CONTRACT

A contractor, O'Kelley, contracted with a city to construct a wharf and dock, executing surety bonds to secure performance. After he had partly performed, the city canceled the contract, upon the ground that he was unable to complete it because of financial embarrassment. The surety was notified and elected to complete the contract in order to protect itself. O'Kelley subsequently sued the surety for $12,608.35, the difference between the amount received by the surety from the city and the reasonable cost of completing the work; and for $3,500 as the value of tools and implements belonging to him which the surety used in doing the work.

Judgment for the contractor was affirmed by the Texas Court of Civil Appeals Lion Bonding & Surety Co., v. O'Kelley, 220 S. W. 1115, for the following reasons. Assuming that the surety company had the right to take over and complete the contract, it did not follow that the contractor then had no further interest in its fulfillment. He was still liable personally for its performance according to the original terms. The defendant's right to undertake its completion was that of a surety acting for its own protection. In a lease, when the surety undertook to complete the contract, it became an agent or trustee for the contractor. It owed him the duty of using reasonable economy and ordinary care and diligence in the performance of that trust. Had the surety elected to leave the work done under its own immediate supervision, it would have been its legal duty, not only to proceed in good faith in the execution of the contract, but to exercise reasonable care and economy in the purchase of material and the employment of labor. The surety did not escape that duty by letting the contract to construction company. It could not arbitrarily agree to a sum for the completion of the work regardless of the conditions under which the contract was made. If the contractor's allegations were true, the surety failed to exercise the proper degree of care, diligence and economy in letting the contract to the construction company, and the evidence was such that the jury might have concluded that the surety carelessly let the contract to the construction company, not only for more than it was reasonably worth to perform that work, but for more than it could, by the exercise of reasonable diligence, have secured a contract for that purpose. There was evidence showing that other competent contractors, had they been given the opportunity, could and would have completed the work for several thousand dollars less than the amount, which the surety agreed to pay the construction company.

GOVERNMENT CONTRACTORS NOT EXEMPT FROM SUITS FOR INFRINGEMENT OF PATENTS

The Circuit Court of Appeals, Third Circuit, holds, Electric Boat Co. v. Lake Torpedo Boat Co., Fed. 670, following the decisions of the Supreme Court of the United States in William Cramp & Sons, etc., Co. v, International Curtiss Marine Turbine Co., 246 U. S. 28, and Marconi Wireless Telegraph Co. v. Sermon, 246 U. S. 46, 38 Sup. Ct. 275, that the Act of Congress of June 25, 1910, giving a right of action in the federal Court of Claims to a patentee whose invention has been "used by the United States without license," cannot be construed as vesting the United States with a general license, nor to entitle a contractor for government work to appropriate a patented invention without liability for its infringement.

SURETY ON IMPROVEMENT CONTRACTOR'S BOND NOT LIABLE ON NONLIENABLE ITEMS

The bond of a contractor on a city public improvement, which undertakes to indemnify the city against any lienable items which would otherwise become a charge against its property, would not ordinarily make the surety liable for any claims against the contractor, although incurred in the performance of the contract, which are not of this nature. Massachusetts Bonding & Ins., Co. v. Chouteau Trust Co., C. C. A., 264 Fed. 793.

NEWS OF THE SOCIETIES

September 13-16—PACIFIC COAST ASSOCIATION OF FIRE CHIEFS. Annual convention Los Angeles, Cal. Secretary, H. W. Bringhurst, Seattle, Wash.

September 13-17—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting San Francisco, Cal. Secretary, A. W. Hedrich, 169 Massachusetts Ave., Boston, Mass.

Sept. 16-18—ENGINEERING INSTITUTE OF CANADA. Meeting to be held at Niagara Falls, Ontario.

September 20-23—SOUTHWESTERN WATER WORKS ASSOCIATION. Annual convention, St. Charles Hotel, New Orleans, La. Secretary, E. L. Fulkerson, Waco, Texas.

Sept. 27-Oct. 21—NATIONAL SAFETY COUNCIL. Ninth annual safety congress at Milwaukee. W. H. Frater, treasurer and business manager, 168 North Michigan avenue, Chicago.

Oct. 12-14—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. St Louis, 401 Lincoln Avenue, Valparaiso, Ind.

October 13-15—AMERICAN CIVIC ASSOCIATION. Annual convention, Amherst, Mass. Secretary, E. F. Marshall, Union Trust Bldg., Washington, D. C.

October 16-19—AMERICAN COUNTRY LIFE ASSOCIATION. Annual conference, Springfield, Mass. President, Kenyon, L. Butterfield, Amherst, Mass.

Oct. 1922—INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. 25th annual convention, New Orleans, La. Secretary, C. R. George, Houston, Texas.

Dec. 7-10—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual meeting. New York Secretary, 29 W. 39th St., New York City.

Jan. 25-27, 1921—THE AMERICAN WOOD PRESERVERS ASSOCIATION. Place of meeting to be announced later.

BRANCHES OF THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

Akron, Ohio, Builders' Exchange

President, John Clemmer; 1st Vice President, Chas. Cott; 2nd Vice-President, Ray Crisp; Treasurer, U. M. Gill; Secretary, J. Brady; Executive Secretary, Philip P. Gott; Directors, Scott Porter, R. C. Armstrong, H. P. Cahill, Claude Wall, H. S. Clark, W. Pickard, Chas. Akers, T. S. McBrier, W. G. Smith.

Buffalo, Builders' Association Exchange

President, Allan I. Holloway; Vice-President, Joseph J. Feist; Treasurer, Townsend Carpenter: Secretary, Frank N. Farrar.

Chicago, Builders' Exchange

President, John Griffiths; Vice-President, Summer Sollitt: Treasurer, John W. Snyder; Secretary, E. M. Craig.

Chattanooga Chapter of the A. G. C.

President, W. S. Holmes; Vice-President, Baxter Bender; Treasurer, Mark K. Wilson; Secretary, Chas. W. Howard, 523-4 James Bldg.

Cincinnati, Contractors' Association

President, G. E. Jones; Vice-President, Eugene Wagner;, Treasurer Wm. S. Scully, Jr; Secretary, Frank Poling; Executive Board, G. E. Jones, J. M. Quill, A. J. Henkel and D. P. Foley.

Cleveland Chapter of the A. G. C.

President, Jas. R. Gloyd; Vice-President, Chas. H. Strong; Secretary, J. T. Hayes; Board of Control, James R. Gloyd, Chas. H. Strong, A. A. Lane, C. F. Mullen, and D. W. Swaty.

Louisville General Contractors' Association

President, D. R. Lyman, Vice-President, F. R. DeLeuil; Treasurer, C. A. Koerner; Secretary, Geo. A. Brinke.

Memphis, General Contractors' Association

President, F. L. McKnight; Ozane & McKnight; Vice-President, J. E. Faires; Treasurer, J. C. Barker; Secretary, E. W. G. Meers; Directors, James Alexander, J. E. Faires, E. G. Hodges, J. M. Reeves, W. T. Hudson, E. J. Pearson, L. T. Lindsey.

New York City General Contractors' Association

President,. Walter J. Drummond; 1st Vice-President, Frederick L. Cranford; 2nd Vice-President, John J. Hagerty; Treasurer, C. Aubrey Nicklas; Secretary, C. A. Crane; Executive Committee, Beaver Engineering & Contracting Co., Borough Asphalt Company, Cranford Company, Emil Diebitsch, Fraser, Brace & Co, Holbrook, Cabot & Rollins Corp, Rodgers & Hagerty, Inc., P. T. Cox Contracting Co., Inc., Degnon Contracting Co., Empire Engineering Co., Inc., John Monks & Sons, Newman & Carey Subway Construction Co., Terry & Tench Co., Inc., Frederick L. Crawford, Inc., Patrick McGovern & Co, Mason & Hanger Co, Inc, North-Eastern Construction Co., Geo. W. Rogers & Co., Smith, Hauser & MacIsaac, Inc., Allen N. Spooner & Son, Inc., Barth S. Cronin Co., F. E. Jones, Stillman-Delehanty-Ferris Co.

Pittsburgh, Pennsylvania Builders' Exchange

President, D. T. Riffle; 1st Vice-President, Geo. T. Heppenstall, 2 nd Vice-President, J. Chas. Wilson; 3rd Vice-President, W. E. Goldman; 4th Vice-President, A. J. Schultz; Treasurer, Eli Abbott; Council, A. W. Forsythe; Secretary, E. M. Tate; Directors, Eli Abbott, H. A. Bloedel, Geo. N. Glass, Keystone Lumber Co., W. E. Goldman, The Barrett Co., Geo. T. Heppenstall, Heppenstall and Marquis; Fred Rebele, Axthelm Electric Co., D. T. Riffle, A. J. Schutz, Schutz, Schreiner and Clyde Co; Ross K. Sefton, S. P. Trimble, W. F. Trimble and Sons Co.; K. J. Chas. Wilson, A. and S. Wilson Co.; Hays M. Junkin, W. S. Miller; A. Q. Starr, Edward Vero.

Philadelphia, Master Builders' Exchange

President, Edwin E. Hollenback; 1st Vice-President, W. Nelson Mayhew; 2nd Vice-President, John R. Wiggins; 3rd Vice-President, Benjamin F. John; Treasurer, Geo. J. Watson; Secretary, Harry C. Woods.

St. Joseph Chapter of A. G. C.

President, P. P. Buddy; Vice-President, Sam Hotchkiss; Treasurer, C. P. Norris; Secretary, E. H. Lawton; Executive Secretary, John H. Vincent.

SOUTHWESTERN WATERWORKS CONVENTION

The ninth annual convention will be held at St. Charles Hotel, New Orleans, Sept. 20-23. A large attendance is expected from the member states, Alambama, Mississippi, Louisiana, Texas, Missouri, Arkansas, Kansas, Oklahoma and New Orleans and from many other parts of the country.

Among the principal subjects presented there will be the following papers and addresses;

Sept. 21, 10 A. M.—Electric Power for Water Pumping—F. D. Mahoney, Birmingham, Ala. Efficiency versus Politics—Joe H. Patterson.

Practical talks of five minutes each by superintendents and members of the Association on little difficulties that have arisen in the experience and the method they used for overcoming them. J. F. Christy, W. F. Hale, L. M. Medlenka.

2 P. M.—Water Supplies of the state and their relation toward public health—Jno. H. O'Neill, Sanitary Engineer. State Board of Health, Louisiana. Round Table Talks: It is a paying investment to meter all fire lines. The upkeep of meter and advantages derived by close inspection—Jesse Shaw, B. L. Ulrich.

September 22nd—Standardization of operating and maintenance cost record of water works system—L. L. Ballard. Popularizing Water—R. E. McDonnell.

Round Table Talks:

How can the water works men assist the State Board of Health in Public Health work? Monthly meeting of all employers. The necessity in this day and time to discounting all bills. F. W. Bird, L. M. Medlenka, W. H. Perkinson.

Structural Engineers' Association of Illinois

At the last annual meeting of the Structural Engineers Association of Illinois, Pres. J. G. Glaver stated that the sole purpose of the association is to protect the rights granted to structural engineers under the law and to secure such additional rights and privileges as could be had by later revision of law, to promote the business of licensed structural engineers and create a better public understanding of the importance of the engineers' activities.

He said that solely through the efforts of this association, the revision of the original license law passed in 1915 was secured, giving to all structural engineers license to practice, all the rights and privileges that the association ask.

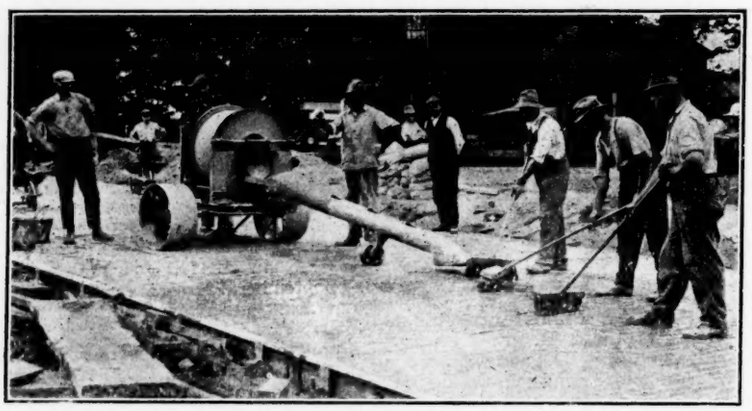
Through the efforts of the association, the Chicago Building Department recognizes the seal of a licensed engineer as equal to that of an architect. Another important achievement was securing a legislative amendment to the general lien law extending full lien rights to structural engineers, and the reduction of the annual fee for the renewal of state licenses from $10 to $1. The practice of structural engineering by one not duly licensed involves a fine and penalty for each day of practice, making such illicit operations extremely unprofitable.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

LAKEWOOD PAVEMENT GROUTER

The grouter mixer manufactured by the Lakewood Enginering Company is adapted to mixing grout for flushing the joints of granite black pavement. It is a small portable machine mounted on a steel truck with two wide-faced wheels and driven by a gasoline engine. Sand, cement and water are supplied by hand and, by the operation of the lever shown in the illustration, the machine discharges into a steel chute with hooded outlet. The chute is pivoted to the truck's frame so that it can be swung to any part of the pavement and is supported near the forward end on a castor so that it can be easily revolved to any position and deliver the grout tothe flushing gang that sweep it thoroughly into all the joints. The machine does the work much more thoroughly and economically than it can be done by hand and save the labor of several men.



FLUSHING GRANITE BLOCK PAVEMENT WITH GROUTER MIXER

BLAW PRUDENTIAL STEEL BUILDING

Catalog 21 of the Blaw-Knox Company describes Blaw-Knox prudential steel buildings formerly manufactured by the C. D. Pruden Company, and for 10 years on the market. After a long and complete investigation of various makes of standardized sectional steel buildings, this type has been selected as giving the most complete service and is now offered, ready for immediate shipment and erection on portable or permanent foundations, adapted to every industrial purposes including light manufacturing, storage and warehousing, machinery housing, bunk houses, power houses, hospitals, truck garages, stockrooms, mess halls and the like.

Among the industrial plant users of Blaw-Knox prudential steel buildings are United States Government Departments, Western Electric Company, several steel and iron companies and many individuals. For construction purposes they have been extensively used for many years by a number of large contractors including James Stewart & Company, Degnon Contracting Company and many others. Many electric and steam railroads, and municipalities use these buildings for freight houses, tool houses, storage sheds, waiting stations and other purposes. Such patrons include the Pennsylvania Railroad, Brooklyn Rapid Transit Company, cities of Pittsburg, Buffalo and others.

The frames of the buildings are made of standard structural steel sections, all shop connections riveted and all field connections bolted. The fabricated sections are designed for a minimum of steel connections and they are standardized, interchangeable and so simple in design that they are easily packed and transported and are rapidly erected by unskilled labor in charge of a competent foreman.

The wall and roof sheets are made of specially pressed galvanized sheet steel in 2-foot widths and the wall sheets, in 8, 10 and 18-foot lengths are bolted top and bottom to the steel framework. The wall studs are made of galvanized sheet metal engaging the wall sheets with an interlocking joint, the roof rafters are similar. The doors have styles and rails of wood covered with pressed steel and may be either swinging or rolling. The windows, hinged either at top or bottom, can be located wherever desired. The buildings can be lined with wood or wallboard.

For industrial purposes, the buildings are from 20 to 50 feet wide and 8 to 12 feet high, made in multiple lengths of 10, 15 and 20 feet. For contractors there is provided a line of standard 20x30-foot bunk houses 8-feet high with a capacity for 16 single or double bunks and type B, 20x50x-8 feet high for 26 bunks. For standard field offices there are the Quixet type 12x20 feet by 8 feet high and the Prudential type 16x30 feet and 8 feet high, while for storage buildings the nine standard sizes vary from 16 feet wide and 8 feet hight to 50 feet wide and 12 feet high in multiple lengths of 10, 16 and 20 feet.

Garages are made in 8, 10 or 12-foot widths, 15 feet, 17 feet 6 inches or 20 feet deep, with or without partitions. Summer cottages are made in 3, 4 and 5-room sizes and can readily be shifted from location to location without the loss of even one bolt.

Convenient, comfortable watchmen's houses are furnished in any length and width multiples of 2 feet 6 inches, with a standard height of 8 feet. Interchangeable doors and windows can be placed wherever desired. A copy of the catalog will be sent free on application.

PERSONALS

Benedict, R. R., formerly assistent superintendent of parks, Kansas City, Missouri, has been appointed assistant state highway engineer, Illinois.

Keith, J. C., has been appointed assistant chief engineer of the Essex Border Utilities Commission with jurisdiction over the water supply, sewerage, and park systems of seven municipalities bordering on the Detroit River.

Andrews, M. O., general manager of the Unit Construction Company, died at Falls River, Mass., Aug. 9.

Miller, W. E., has opened an engineering office in Madison, Wisconsin, for investigations and studies of steam and electric railway and public utility problems, designing, estimating and supervising construction.

Dyatt, A. E., has been appointed resident engineer of Kansas Federal Aid Project 7, Douglas Co., Kans.

Bonar, S. H., has been appointed city engineer of Moundsville, W. Va.

McDermott, J. R., has been appointed assistant division engineer of West Virginia State Road Commission, with headquarters at Keyser, W. Ba.

Miller, W. E., has opened an engineering office in the Pioneer Block, Madison, Wisconsin, specilizing in railway and public utility work.

Sifferlen, C. E., has been appointed instructor in forest engineering at the New York State College of Forestry, Syracuse. New York.

PROBLEMS THAT CITIES ARE STUDYING WITH EXPERTS

The city of Baltimore has appointed a Port Improvements Commission, J. E. Greiner at the head, to govern the expenditure of $50,000,000 authorized by the Maryland Legislature.

It has also appointed a general improvement commission to take charge of the expenditure of $26,000,000 on street paving sewers and other work.

Matthes, G. H., has been appointed assistant engineer of the U. S. Engineer Office at Chattanooga, Tenn., in charge of investigation of the Tennessee River with special reference to water power, flood control and mineral resources.